

## DOCUMENT RESUME

ED 463 165

SE 065 815

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TITLE Traditional or Problem-Centered Mathematics? The Choices of Students and Parents in One District.  
PUB DATE 2002-04-00  
NOTE 23p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April, 1-5, 2002).  
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)  
EDRS PRICE MF01/PC01 Plus Postage.  
DESCRIPTORS \*Academic Achievement; College Admission; College Bound Students; High Schools; \*Mathematics Curriculum; \*Mathematics Instruction; Parent Influence; Sex Differences; \*Socioeconomic Influences; Student Attitudes  
IDENTIFIERS Core Plus Education

## ABSTRACT

This study focuses on one district that recently began offering high school students a choice between its traditional algebra sequence and a new, integrated sequence based on Core Plus texts. The students in this district have experienced problem-centered instruction throughout elementary and middle school. However, when 600 students and their parents were asked to choose between the 2 high school options, over 82% chose the traditional sequence. Additionally, significantly more females than males chose the traditional sequence. Students and parents were surveyed about the factors underlying their choices. These factors were analyzed with attention to option choice, SES, and gender. Overall, parents who preferred the traditional sequence were less concerned about the development of real-world problem solving skills or their children's enjoyment of mathematics, and focused instead on the curriculum's potential to prepare students for future academic hurdles (e.g., college entrance). Lower-SES parents were most concerned about their children's college preparation and were also most likely to be influenced by teachers' advice, despite the fact that they were least likely to have actually talked with teachers directly. Comparisons of decision factors by gender revealed few strong patterns, but the data do suggest that, contrary to common wisdom, males may be more likely than females to enjoy working in groups in mathematics classrooms. Additionally, more males than females reported wanting to be challenged in their mathematics class. Overall, the data indicate that, after years of experience with Standards-based instruction, many parents and students in this community hold strong, persistent anti-reform beliefs. This study highlights the enormous difficulty of introducing change into the firmly entrenched mathematics curriculum, particularly at the high school level. Increased understanding of students' and parents' concerns about mathematics instruction can better position reformers, administrators, and teachers to implement mathematics instruction that best meets students' needs. (Contains 18 references.) (Author/MM)

# Traditional or Problem-Centered Mathematics? The Choices of Students and Parents in One District.

Sarah Theule Lubienski

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# Traditional or Problem-Centered Mathematics? The Choices of Students and Parents in One District

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Paper presented at the annual meeting of the  
American Educational Research Association, April, 2002, New Orleans.

## Abstract

This study focuses on one district that recently began offering high school students a choice between its traditional algebra sequence and a new, integrated sequence based on Core Plus texts. The students in this district have experienced problem-centered instruction throughout elementary and middle school. However, when 600 students and their parents were asked to choose between the two high school options, over 82% chose the traditional sequence. Additionally, significantly more females than males chose the traditional sequence.

Students and parents were surveyed about the factors underlying their choices. These factors were analyzed with attention to option choice, SES, and gender. Overall, parents who preferred the traditional sequence were less concerned about the development of real-world problem solving skills or their children's enjoyment of mathematics, and focused instead on the curriculum's potential to prepare students for future academic hurdles (e.g., college entrance). Lower-SES parents were most concerned about their children's college preparation and were also most likely to be influenced by teachers' advice, despite the fact that they were least likely to have actually talked with teachers directly. Comparisons of decision factors by gender revealed few strong patterns, but the data do suggest that, contrary to common wisdom, males may be more likely than females to enjoy working in groups in mathematics classrooms. Additionally, more males than females reported wanting to be challenged in their mathematics class.

Overall, the data indicate that, after years of experience with Standards-based instruction, many parents and students in this community hold strong, persistent anti-reform beliefs. This study highlights the enormous difficulty of introducing change into the firmly entrenched mathematics curriculum, particularly at the high school level. Increased understanding of students' and parents' concerns about mathematics instruction can better position reformers, administrators, and teachers to implement mathematics instruction that best meets students' needs.

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<sup>1</sup> The author would like to thank Ames teachers, students, and parents for their participation in this study, and Tony VanderZyl for his support of this research. Additionally, the author deeply appreciates the research assistance of Kayonna Camera and the research support provided by the Iowa State University College of Education.

In spring, 2000, the National Council of Teachers of Mathematics (NCTM) published Principles and Standards of School Mathematics, affirming its decade-old vision of mathematics teaching centered around problem solving, student reasoning, and classroom discourse. The Standards have become the subject of much debate among educators and policymakers, yet we know little about what most students and parents make of the reforms, including how they might choose between Standards-based and traditional instruction, if given the choice.

In writing about NCTM's struggles to reach parents, past NCTM President Jack Price (1996) stated: "What has been most distressing since we released the Standards documents is that our efforts to inform parents better have fallen short (p. 606). Peressini (1998) calls for proactive, rather than reactive, approaches to involving parents in school mathematics reform. The recent backlash against Standards-based mathematics in California highlights the importance of this point.

Although reformers have argued that parents need to be convinced of the importance of the Standards, little attention has been given to parents' beliefs and goals, including how these are or are not compatible with current reforms. A proactive approach must be built upon deeper understandings of parents' desires and concerns for their children's mathematics learning. Additionally, researchers and educators should not view parents as a homogeneous group, but should instead seek to understand their diversity.

Past research suggests that socioeconomic differences, in particular, shape parents' involvement with, and perspectives on, schooling (Lareau, 1989). Upper-middle class parents tend to have more access to information about school policies and reforms, including those relating to mathematics curriculum and instruction (McGrath & Kuriloff, 1999).

In addition to parent attitudes, there is much to learn about students' attitudes toward reform-based instruction (McLeod, 1992). Lubienski's study of students in one reform-oriented classroom suggests ways in which lower-SES students could be less comfortable with reform-based instruction than their higher-SES peers. Other researchers have also described ways in which social class influences students' interpretations of real-world problems (e.g., Cooper & Dunne, 2000; Walkerdine, 1990). Hence, social class is one important factor to be considered in relation to both parents' and students' perspectives on instruction that emphasizes real-world problem solving as a means to learning mathematics.

Gender is another factor to be considered, particularly in relation to students' views on mathematics instruction. Many scholars have argued that girls are particularly likely to enjoy and benefit from teaching methods that emphasize students' personal construction of mathematical ideas through problem solving and cooperative group work (e.g., see Becker, 1995; Boaler, 1997; Damarin, 1990; Isaacson, 1990; Morrow & Morrow, 1995). Still, the question remains whether most girls choose reform-based instruction over traditional instruction, if given the choice.

This study examines students' and parents' perspectives on Standards-based mathematics instruction, including how these perspectives differ by SES and gender. Increased understanding of these perspectives can better position reformers, administrators, and teachers to implement mathematics instruction that best meets students' needs.

## THE STUDY

A recent development in the Ames (Iowa) Community School District, provides a unique opportunity to examine parent and student attitudes toward mathematics reform. Ames is a relatively affluent district encompassing Iowa State University, but the district also serves students from lower- and working-class backgrounds. Ames students are primarily Caucasian, with Asian students making up the largest ethnic minority group. Although a more ethnically and socioeconomically diverse setting would have been desirable for a general study on student and parent attitudes toward instruction, Ames was chosen because of the particular changes in mathematics instruction occurring there.

Almost a decade ago, Ames elementary instruction changed to include Cognitively Guided Instruction and the Standards-based Investigations mathematics curriculum. Ames also began piloting the Mathematics in Context (MIC) materials in grades 5-8. Despite controversy in the community about the transition to these materials, the national MIC implementation coordinators identified Ames as a model of how districts should address parents' concerns about curriculum reform (Meyer, Delagardelle, and Middleton, 1996). Additionally, the Ames middle school was recently described by one teacher as an exemplary, supportive environment for facilitating mathematics teacher change (Almond, 2001). As of 2001, the district is still using Investigations and MIC for its elementary and middle-school curricula.

However, traditional instruction at the high school level remained unchanged until fall, 2000, when the district's "Mathematics Cabinet"<sup>2</sup> and teachers introduced a four-year, integrated mathematics sequence based on the new, NSF-funded, Core Plus texts. Given the controversies that arose in the community upon the transition to MIC, district leaders decided to offer parents and students a choice between the traditional track (Algebra, Geometry, Algebra II, Pre-Calculus) and the new, integrated, Core Plus option.

In spring, 2000 (and again in 2001), the district held a parent meeting to prepare parents of 8<sup>th</sup> graders for the transition to high school. A meeting was also held specifically for parents of accelerated 6<sup>th</sup> and 7<sup>th</sup> grade students who would be taking Algebra or Integrated at the middle school the following year. At these meetings, the district's mathematics coordinator and teachers explained the differences between the two mathematics options. The traditional Merrill Algebra 1 text (copyright 1992) and the Core Plus texts were made available for parents to examine at these meetings. Additionally, information about the two options was sent home to parents in school newsletters, and was presented via local-access television. Website addresses were also provided for parents who wanted to examine more detailed information about the Core Plus curriculum (e.g., pilot testing data, etc.). When describing the two curricula to parents and students, the district characterized their differences as follows:

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Traditional Algebra Sequence	Integrated Sequence (Core Plus)
<ul style="list-style-type: none"> <li>◦ Mathematics strands are studied separately, one each year.</li> <li>◦ Teacher demonstrates.</li> <li>◦ Students practice.</li> </ul>	<ul style="list-style-type: none"> <li>◦ Mathematics strands are integrated each year.</li> <li>◦ The teacher guides and assesses (using multi-dimensional assessment).</li> <li>◦ Students investigate real-life contexts (often in groups) and develop a rich understanding of mathematics that enables them to solve new problems.</li> </ul>

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<sup>2</sup> The Ames Mathematics Cabinet is made up of local teachers, parents, community representatives and the district's mathematics coordinator. As a representative of Iowa State University's College of Education, the author has been a member of the cabinet since 1999.

Since fall, 2000, 600 Ames students (typically 8<sup>th</sup> or 9<sup>th</sup> graders) and their parents have chosen between the traditional sequence (Algebra, Geometry, Algebra II, Pre-Calculus) and the new, integrated, Core Plus option. In this context, the following questions were examined:

- 1) How many students chose traditional algebra, and how many chose the integrated, Standards-based option? Were there patterns in terms of option chosen that correlated with prior achievement, SES, or gender?
- 2) What factors influenced student and parent choices between the two options? Were there patterns in terms of influencing factors that correlated with student gender or SES?

These two questions have been the focus of the first two years of this study. Over the next several years, students' achievement gains and attitudes will be compared between the two mathematics options.

## METHOD

With input from district mathematics teachers and administrators, the researcher developed a parent/guardian permission form and survey, as well as a student survey. The forms and surveys were distributed to all Algebra I and Integrated I students/parents in fall, 2000 and 2001. Of the 600 students involved, permission was obtained from parents of 375 students, with parent surveys completed for 333 of those 375, and student surveys completed for 338 of the 375.

The parent survey listed 13 possible factors that influenced their decision between Algebra or Integrated Mathematics. Examples of listed factors included, "Your student wanted to take Algebra (or Integrated)," "You thought your student would understand math better in Algebra (or Integrated)," or "You thought Algebra (or Integrated) would better prepare your student for college." Parents were asked to rank the four most important factors, and space was provided for parents to elaborate on their choices or to provide additional factors not listed. Based on parents' comments on the survey administered in fall, 2000, three additional factors were added to the survey in fall, 2001. These factors were, "You thought an older, traditional program would be better than a new program," "You thought your child could get more help at home if taking Algebra (or Integrated)," and "You thought Algebra (or Integrated) would best fit your child's learning style" (with a prompt and space provided to explain his/her learning style).

Parents were also given a list of possible information sources about the two programs (e.g., school newsletter, parent night, etc.) and asked to check all those they accessed when making their



decision. Finally, parents were asked to indicate the highest level of schooling obtained by either parent in the household. This parent education indicator was used as an approximation for students' SES.<sup>3</sup>

Participating students completed surveys in their mathematics classes. Like their parents, they were asked the reasons underlying their choice to be in Algebra or Integrated Mathematics. In Year 1, this question was asked as an open-ended response item. The factors given by both students and parents in Year 1 helped shape the Year 2 survey, which paralleled the parent survey by asking respondents to rank the four most important factors from a list provided or to write in their own responses. Students were also asked several open-ended and close-form questions about their experiences in their mathematics classes, as well as about their attitudes toward, and confidence in, mathematics. These data will be used for later analyses, but are occasionally discussed in this paper in relation to parent and student choices.

Analyses of open-ended survey items were largely inductive. In addition to the categories used as pre-defined options on the parent surveys, over a dozen new categories of parent and student reasons were developed in the analysis of open-ended responses. Then, crosstabulation tables were used to examine the prevalence of both pre-defined and newly emergent parent/student decision factors, looking for patterns relating to option choice, parent education level, and gender. T-tests and regression analyses were used to test such patterns for significance (using .05 as the critical p-value). Similar analyses focused on information sources parents accessed when making their decision.

Parent education was examined using both a Boolean variable (indicating whether at least one parent is college educated or not), and a 4-step ordinal variable that distinguished among students who had at least one parent with no college degree (11%), Bachelor's degree (27%), Master's Degree (23%), and Ph.D. (38%). Hence, the vast majority of sampled students had college-educated parents, with over one third having a parent with a Ph.D.

Race was considered, but results are not reported here, due to the small sample sizes and consequent district concerns about student confidentiality. Additionally, there is great diversity within the ethnic groups sampled because of the substantial international population in Ames. Hence, for example, many of the "Asian" students are not Asian American, but are actually

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<sup>3</sup> The highest education level of either parent in the household is commonly used as a primary SES indicator. For example, this method is frequently used by the National Assessment of Educational Progress.



citizens of a wide variety of countries. Hence, discussing these students as a single group is less useful in this context than in other contexts in which ethnic groups are more homogenous.

In addition to the surveys collected from participating students and parents, the researcher had access to general data (with names removed) for all 600 students involved. These data included students' option choice, gender, and previous test scores. Students' option choices (Algebra versus Integrated) were compared between males and females using a Chi square test. Algebra and Integrated students' previous test scores were compared with t-tests to determine whether higher- (or lower-) achieving students were more likely to choose one option or the other. Regression analyses were used to examine test score differences while controlling for other variables (e.g., grade level).

## RESULTS

### Integrated and Algebra Enrollment

The district's mathematics coordinator and many mathematics teachers and administrators fully supported the Integrated option and hoped that many students would choose that option. However, relatively few students did. Despite the district's implementation of Standards-based elementary and middle school curricula several years ago, and despite the district's efforts to promote the Integrated sequence, less than 18% (107) of the 600 eligible students/parents chose the Integrated option. However, this percentage varied by prior achievement, SES and gender.

Because of its importance as a potential confounding variable, grade level differences must be discussed before addressing patterns related to achievement, SES and gender. A greater percentage of the accelerated middle school students (27%) than high school students (13%) chose Integrated Mathematics. The district's mathematics coordinator and a middle school mathematics teacher, both of whom were instrumental in informing parents about the options, believe that these enrollment differences are due, at least in part, to their more active promotion of the Integrated option in the parent meeting for accelerated middle school students. (The high school meeting served a larger variety of purposes, allowing less time for discussion of the mathematics options.)

For years, the district has regularly administered both traditional and non-traditional standardized mathematics assessments (e.g., Iowa Test of Basic Skills, New Standards Reference Examination). On average, the Integrated students had higher standardized mathematics test scores than the Algebra students. However, the difference was only significant for scores on the

Algebra Aptitude test, which is administered at the middle school level to inform acceleration decisions. Because there were more middle school students in Integrated, and because all middle school students in the sample were accelerated, grade level is a potential confounding variable in the correlation between course and Algebra Aptitude test scores. When controlling for grade level, there were no significant differences in test scores.

Parent education level correlated positively with Integrated enrollment. For example, whereas only 8% of students with non-college-educated parents were in Integrated mathematics, 31% of students with a Ph.D.-holding parent were in Integrated. However, again, grade level must be considered a confounding variable, because more students of parents with doctorates were accelerated and therefore making this choice in middle school, and more middle school students chose Integrated. When controlling for grade level, the correlation between option choice and parent education level was still present but weaker and no longer significant.

Although the literature on gender differences in learning preferences might seem to suggest that more girls than boys would choose Integrated mathematics, the opposite occurred. The number of boys in Integrated Mathematics was almost 50% higher than the number of girls in Integrated (see Table 1). These results should be interpreted with caution, because some students' choices were influenced by those of friends (and, therefore, the students were not acting independently). However, this pattern was consistent in each year of the study, as well as at both the middle and high school levels.

Table 1: Mathematics Option Choice by Gender

	<b>Algebra</b>	<b>Integrated</b>	<b>Total</b>
<b>Males</b>	239 78.9%	64 21.1%	303 100.0%
<b>Females</b>	254 85.5%	43 14.5%	297 100.0%
<b>Total</b>	493 82.2%	107 17.8%	600 100.0%

The above data raise the question: In the context of a district that was deemed successful in its implementation of Standards-based K-8 instruction, why are so many parents and students

(including disproportionate numbers of females, and to a lesser extent, lower-SES students) choosing the traditional algebra option? Examinations of data on parents' and students' reasons for their choices shed light on this question.

### Parents' and Students' Decision Factors

When parents were asked to indicate the four most important factors influencing their mathematics option choice, students' desires (51%) and college preparation (45%) were selected most frequently (see Table 2). Desiring greater student understanding of mathematics (40%), preferring the course's mathematical content (34%), and student enjoyment were also popular responses.

Table 2: Top 5 Decision Factors for Parents and Students

Parent Responses	Student Responses <sup>4</sup>
Student wanted (51%)	Parents wanted (30%)
College preparation (45%)	Understanding (24%)
Student understanding (40%)	Enjoyment (24%)
Course content (34%)	Less like Middle School (23%)
Student enjoyment (27%)	College preparation (20%)

Students' reasons for their option choice differed from those given by parents. Parent's wishes was the factor most often cited, with 30% of students listing this as a primary reason for their choice. Wanting to enjoy mathematics, understand mathematics, take the course least like middle school math were also popular reasons, each being mentioned by roughly 24% of students. College preparation was the next most popular reason, mentioned by 20% of students.

### Parent and Student Factors by SES

Parents' reasons for their choices varied significantly by parent education level (see Table 3). For lower-SES parents, college was by far the most important decision factor, named by 70% of lower-SES parents. Parents with limited education were also significantly more likely than

<sup>4</sup> Percentages are lower for students' responses than parent responses, because the student survey question was completely open-ended the first year of administration. The percentages include both year 1 and year 2 students.

college-educated parents to indicate that a teacher's or counselor's advice to their child influenced their decision.<sup>5</sup> In contrast, desires for students to enjoy and better understand mathematics were mentioned significantly more often by parents holding college degrees.<sup>6</sup>

Table 3: Top 5 Parent Decision Factors, by Parent Education Level

<u>H.S.</u>	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
College 70%	Student wanted 57%	Student wanted 56%	Student wanted 53%
Student wanted 49%	College 54%	Understand 52%	Understand 46%
Content 43%	Understand 39%	College 46%	College 45%
Teacher Advice 38%	Content 37%	Content 42%	Stdnt enjoyment 38%
Real life 35%	Stdnt enjoyment 28%	Real life 33%	Content 33%

There was much less variation in students' responses across parent education levels. In fact, the top four reasons for each group were the same: Parent's wishes, wanting a course less like middle school math, enjoyment, and understanding. The ordering of these four varied, somewhat, with parent advice being mentioned more often by students with college-educated parents. However no differences were statistically significant.

Information sources were also examined by parent education level. Significantly more higher-SES parents accessed information through parent nights, teachers, and textbooks (see Table 4). School newsletters appeared to be the most equitably accessible information source, with roughly 40-50% of parents from each category indicating this was an information source for them. Additionally, newsletters were the primary source of information for parents with limited formal education. Over 20% of high-school educated parents reported having no information about the two options (this was about double the percentage of other parents). Although 38% of high-school educated parents reported that their decision was influenced by their child's teacher (see Table 3), only 27% actually talked with a teacher. A careful comparison of the survey

<sup>5</sup> The percentages for teacher advice were 38% for non-college-educated parents versus 21% for college-educated parents. Percentages for counselor advice were 19% for non-college-educated parents versus 5% for college-educated parents.

<sup>6</sup> The percentages for student enjoyment were 22% for non-college educated parents, and 32% for college-educated parents. Percentages for understanding were 27% for non-college educated parents, and 46% for college-educated parents.

questions' wording along with analyses of parent and student written comments suggest that parents with limited education tended to be influenced indirectly through statements made to their child by a teacher. In contrast, although over 40% of college-educated parents reported discussing the options with a teacher, only about 20% indicated that teacher advice was a major influence on their decision.

Table 4: Percentage of Parents Reporting Access to Various Information Types, by Education

<u>H.S.</u>	<u>B.A.</u>	<u>M.A.</u>	<u>Ph.D.</u>
Newsletter 41%	Parent night 63%	Parent night 57%	Parent night 57%
Parent night 32%	Newsletter 51%	Discussed w/ tea 43%	Discussed w/ tea 41%
Discussed w/ tea 27%	Discussed w/ tea 41%	Newsletter 42%	Newsletter 39%
No Info. 22%	Texts 19%	Natl. trends 33%	Texts 36%
Natl. trends 19%	Natl. trends 12%	Texts 23%	Natl. trends 33%
Texts 11%	No info. 9%	No info 14%	No info 9%

#### Parent and Student Factors by Gender

Data were examined for correlations between student gender and parent/student rationales for their option choice. Only one significant difference between parents of boys and parents of girls was found: More parents of girls said that they chose the mathematics option that would be easier for their child. Still, the numbers were small, with 11% for girls' parents, and 4% for boys' parents.

Students' reasons varied by gender, with two significant differences found. More boys than girls said they wanted a mathematics course that would be challenging (15% boys versus 6% girls). More girls than boys wrote in (because it was not a given response) that they did not want to work in groups (18 girls versus 7 boys).

Gender differences were also examined on a variety of questions regarding students' role in their Algebra and Integrated classrooms. Although these data are not the focus of this paper, some findings relate to the trends in students' decision factors and will therefore be discussed here.

Students were asked how they feel when stuck on a mathematics problem. Significantly more boys (56%) than girls (45%) chose the response, "Challenged, and I enjoy this challenge."

Additionally, students were asked how often they work in groups during their mathematics class. More boys than girls reported working in groups on a daily basis, and more girls than boys reported never or hardly ever working in groups. However, this is not surprising in light of the fact that more boys than girls are in Integrated mathematics. However, the gender difference in group work is significant even after controlling for course taking differences. For example, whereas 45% of girls in Algebra report working in a group “never or hardly ever,” only 29% of boys report this. Thus, the data regarding students’ choices and behaviors in mathematics class suggest that, contrary to conventional wisdom, girls may be less likely than boys to prefer working in groups.

#### Parent and Student Factors by Option Choice

There were several significant differences between the parents of students in Algebra and Integrated Mathematics (see Table 5). Parents of Integrated students were significantly more likely to indicate student understanding, student enjoyment, and real life preparation as reasons for their course choice.<sup>7</sup> Parents of Algebra students were significantly more likely to identify college preparation, course content, teacher advice to their student, and a desire to have a course less like middle school mathematics as reasons for their choice<sup>8</sup>.

Table 5: Top 5 Parent Decision Factors, by Course

<b>Algebra</b>	<b>Integrated</b>
Student wanted 51%	Understand 52%
College 51%	Student wanted 51%
Content 38%	Enjoyment 48%
Understand 36%	Real life 43%
Teacher Advised 29%	College 29%

<sup>7</sup> Whereas 52%, 48% and 43% of Integrated parents chose student understanding, enjoyment, and real life preparation, respectively, as reasons for their decision, the percentages for Algebra parents were only 36%, 20%, and 18%.

<sup>8</sup> Whereas 51%, 38% 29%, and 17% of Algebra parents identified college preparation, course content, teacher advice to student, and wanting a course less like middle school mathematics, respectively, as decision factors, the percentages for Integrated parents were only 29%, 23%, 17% and 7%.

Information sources were also examined by course. Significantly more Integrated parents (70%) than Algebra parents (51%) attended a parent night. Additionally, significantly more Integrated parents (55%) than Algebra parents (34%) discussed options with teachers. Whereas 37% of Integrated parents said they were aware of national trends, only 21% of Algebra parents indicated this. Algebra parents (15%) were more likely than Integrated parents (2%) to report having no information about the options. These significant differences persisted even after controlling for grade level and parent education level.

Many patterns in the student survey data are similar to trends noted in the parent data. Significantly more Algebra students than Integrated students identified college preparation and wanting a course less like middle school mathematics as primary decision factors. Also, as with parents, more Integrated than Algebra students identified enjoyment, understanding and real life preparation as decision factors. However, opposite the parent survey results, more Integrated than Algebra students said that teacher advice influenced their decisions. Additionally, significantly more Integrated than Algebra students said they chose their course because they thought it would be easier or would match their learning style, whereas more Algebra than Integrated students said that an aversion to group work influenced their choice.

*Written responses: A closer look at student and parent opinions*

Many parents and students wrote comments on their surveys regarding why they chose Algebra or Integrated mathematics. Some of the comments merely elaborated on existing response options provided on the survey, and other comments added reasons that were not among the listed options. The following is a representative subset of these student and parent comments:

Algebra Students:

*I wasn't sure if colleges accepted Integrated math, so I decided on Algebra.*

*My brother took Algebra, and I thought I'd get help and be easier to take Algebra than Integrated Math.*

*I wanted to prove that I was smarter than my other friends.*

*I got a good score on the Algebra aptitude test.*

*Algebra is real math. I can use Algebra later in life. It has been used for years and has been successful. My dad is a scientist/mathematician and said Integrated was worthless.*

*I didn't like the idea of being the first group of students to go through this program. I didn't like the idea that you were stuck for three years and if you got out you had to retake Alg., Geom. etc.*



*I wouldn't like all of those mixed things and ideas, I like building up.*

*I learn better with being taught how to do something instead of figuring it out.*

*I was getting confused with the MIC math system and I just like getting problems that I can understand.*

*I figured it might be like MIC math so I didn't do Integrated. I would rather just do problems without expanding or pondering stuff.*

### Integrated Students:

*I learn better with questions from stories and stuff (like the MIC math in middle school).*

*I like to figure things out and find out why/ how they work—Integrated supports this.*

*I thought it would be easy, because MIC math was easy. I wouldn't have to memorize rules like in Algebra.*

*My great uncle said I should try it (he's a math teacher). This way I don't do the same thing all year.*

*You get to work in groups.*

### Algebra Parents

*We did not want to "experiment" with our child's education and worried about transferability of material to another school if we moved.*

*Our other older children had taken Algebra in eighth grade.*

*Because we took Algebra.*

*He does not like work in groups and likes to practice problems after a teacher models examples.*

*Math in Context has done more harm than good for 4 out of 4 of my children. At the lower levels, time spent on basic facts and concepts is being slighted so that more time can be spent on "real-world" situations that often involve thinking skills considerably above the students current conceptual ability level and using skills they have not been taught yet.*

*I am very leery of yet another "new and innovative" way to teach math. I am not going to risk another disaster with my daughter, who is still recovering from MIC.*

*MIC math was totally frustrating to many students and parents. It might have been OK for the top elite math students, but not for most students.*

### Integrated Parents

*More hands on, not just do problems, applies to real life.*

*The variety sounded better than doing algebra every day all year.*

*My son likes working in groups and reasoning about solutions.*

*A new, more interesting method of teaching math.*

*Integrated math was "pushed" as the "new future" at the welcome to high school meeting.*

An analysis of parent and student comments revealed several decision factors that, although not necessarily prevalent among a majority of respondents, reveal important issues underlying many parents' and students' decisions.

Particular learning style issues were mentioned by many students and parents. Fourteen students said they chose Algebra because they did not want to have to learn various concepts simultaneously and instead preferred learning algebra one year, geometry the next, etc. Additionally, several students said they chose Algebra because they wanted mathematics that is "straightforward" and/or did not want to "explain why" when completing mathematics work. Algebra students said they preferred having the teacher explain how to solve problems and then practicing instead of figuring out their own methods. Several Integrated students mentioned group work, hands-on learning, and an emphasis on reasoning when explaining why they preferred Integrated.

Whereas the majority of written comments from Integrated parents and students referred to students' learning styles matching Integrated instruction, the majority of comments from Algebra students and parents referred to two aspects: Issues of scale/sequence (relating to "Algebra" being the established, widespread norm), and a dislike of MIC mathematics.

Issues of scale and sequence arose in a variety of ways in Algebra students' and parents' explanations for their choice. First, despite school administrators' attempts to present the two courses as equal but different "options" (as opposed to "tracks"), several student and parent responses suggest that Algebra was viewed as "real" mathematics, whereas Integrated was viewed as less rigorous and more suitable for students not yet ready for Algebra. Some students referred to their scores on the "Algebra Aptitude Test," annually administered to sixth-grade students, and seemed to assume that a high score on that test implied "Algebra" was the sensible choice. Additionally, several students indicated that they had already learned some algebra (e.g., at summer programs) and therefore wanted to be in "Algebra." Dozens of students and parents said that family tradition was a factor, preferring the course that parents and/or older siblings took (in part so that help could be provided at home). Furthermore, several Algebra students and parents mentioned that they might move in the near future and were concerned that Integrated would not match what other schools were doing. Finally, many others worried that Integrated mathematics would not adequately prepare students for traditional college course work or be considered valid by colleges.

All of these factors highlight the great difficulty of introducing change into the firmly entrenched high school mathematics curriculum. Parents' beliefs were rooted in their experiences with their schooling, as well as that of their older children. Despite the district's attempts to promote change, its established "algebra" assessment biased parents and students toward algebra, just with its name. Additionally, even when students or parents believed there were intrinsic benefits of the Integrated curriculum, concerns remained about whether the new course sequence would mesh with mathematics courses in other communities or colleges. These issues combine to make curricular change in any single school district exceedingly difficult.

Still, by far, the most prevalent and passionate comments on both student and parents surveys were those that pertained to a disdain for the Standards-based mathematics instruction occurring at the elementary and middle school. Despite the use of such approaches for several years, many parents and students continue to bitterly resent reform-oriented instruction. In particular, anti-MIC sentiments were expressed as a factor for choosing Algebra by 51 parents and 32 students. (In contrast, fewer than a dozen students or parents made positive comments specifically about MIC mathematics.) In addition to concerns voiced directly about the MIC curriculum, many additional parents and students made anti-reform comments indirectly, such as use of the terms "guinea pig" or "fad." For example, one Algebra parent wrote, *"I prefer time-tested useful math, than some fad perpetuated on us by an 'educator' ..."*

The researcher discussed these comments with the district mathematics coordinator and a few mathematics teachers. Through these conversations and analyses of parent/student survey data, several hypotheses have emerged regarding why so many in the community hold such negative views of MIC mathematics. First, there was apparently some slippage in test scores the first year that MIC was implemented. Despite the fact that MIC may not have been responsible for this slippage (having only been in use a few months at the time the tests were taken), and despite the fact that test scores have not shown any long-term declines, some parents continue to believe that students do not learn their basics with MIC. Additionally, some evidence indicates that a few teachers who were being asked to use MIC had reservations about the program and did not hide this fact from parents. This has served to fuel the fire of parental resistance to the curriculum. Additionally, some comments on parent surveys indicate a lack of faith in teachers' ability to implement Standards-based approaches well.

## DISCUSSION

As a district considered successful in reforming its elementary mathematics programs, the case of Ames highlights how passionately and persistently many parents and students resist high school curricular reform. As districts like Ames work toward implementation of Standards-based curricula, they will need to understand and address students' needs and parents' concerns.

This study provides insights into these needs and concerns, including how they can vary by SES and gender. For example, parents, particularly those with limited formal education, were very concerned about their children's preparation for college. Districts hoping to reform high school mathematics instruction will need to actively address the perception that algebra is "real," college-preparatory mathematics, and that colleges will not recognize Integrated mathematics. Reformers must provide clear information about ways in which colleges are handling Standards-based mathematics credit. Arguments for reform based on students' enjoyment of mathematics, the need for real-world problem solving skills, or the benefits of student discovery were unconvincing to the majority of parents in this study. Parents who chose algebra tended to believe that a traditional curriculum is necessary for college and that students understand that curriculum better when taught in clear, direct ways.

Many schools hold parent or family math nights to help parents understand, first-hand, the benefits of reform-based instruction. Although such events can be helpful to the parents who attend, the low-SES parents in this study were more likely to access information through school newsletters than parent nights. This study also suggests that teachers can be particularly important influences on the curricular decisions of low-SES families, even though, ironically, the low-SES parents in this study were the least likely to discuss issues directly with teachers. Teachers should not underestimate the power of their comments made to low-SES students — this study suggests that low-SES parents are both aware of, and influenced by such comments.

After having reform-based instruction throughout elementary school, many students argued that they prefer learning in a "straight forward" manner, and that they learn best when teachers explain and provide guided practice. Indeed, the vast majority of students in this study chose traditional instruction, with "understanding" and "enjoyment" often given as primary reasons for their choice. These findings challenge the rhetoric of reform that suggests that all students will experience learning through problem solving as more beneficial and enjoyable than traditional instruction (NCTM 1989; 1991; 2000). These students' concerns echo those raised in another

study of students' reactions to reform, particularly the reactions of lower-SES females (Lubienski, 2000). This is not to say that problem-centered instruction does not actually benefit students, but that many students do not *perceive* such benefits, and instead feel confused and frustrated. In order to address these feelings, teachers could help students understand the benefits of reform-based instruction that have been identified by researchers (e.g., Schoenfeld, 2002), and could actually conduct classroom-based research that would allow students to examine their own growth in, and retention of knowledge.

This study also raises the issue of gender in relation to students' and parents views on mathematics instruction. More boys than girls chose Integrated mathematics. More boys than girls said they wanted to be challenged in their mathematics classes, and more parents of girls than boys said they chose the option they thought would be easier for their child. Additionally, contrary to what is currently assumed, the girls in this study appeared less likely than boys to prefer working in groups. These are important findings, but the numbers pertaining to these issues were relatively small. Hence, further research is needed to uncover the reasons for these patterns, as well as to examine whether these patterns exist in other populations.

Limitations of this study include the fact that Ames is not representative of all school districts, and the survey sample included only those students for whom parents permission was obtained. Significant differences (particularly those involving gender) must be viewed with caution, given that the sample was not random and students were not acting independently (due to friends influencing some students' decisions). Further research is needed in more ethnically diverse districts to examine the role that ethnicity plays in student and parent perspectives on mathematics instruction.

## CONCLUSION

Overall, the case of Ames raises questions about the staying power of the NCTM reforms. In Ames, a significant contingent of parents and students continue to actively resist the reforms already in place and do not support efforts to create a viable Standards-based option at the high school level. This study highlights the need to gain broad-based parental support for reforms, but also reveals the difficulty of doing so, given the diversity and deep-rooted nature of parents' beliefs.

A significant portion of parents' resistance to integrated, reform-based mathematics would naturally be addressed if such instruction became more prevalent nation-wide. For example, if integrated mathematics became the "norm" in U.S. high schools, parents' concerns about transferability to other districts and to colleges would diminish.

However, currently, changes are occurring in isolated districts. The majority of Ames' parents appear less interested in test scores from other districts and more influenced by their own and their community's experiences with MIC mathematics. This speaks to the importance of a curriculum being proven successful in the local district, as opposed to elsewhere. When end-of-high-school test score data from the first few cohorts of Integrated students become available, beliefs about Integrated being less rigorous and less beneficial than Algebra could be challenged.

However, most Ames parents appear to have given little consideration to local, long-term test score trends related to MIC mathematics implementation. Instead, the majority of parents with concerns about MIC mentioned their own child's experiences, such as their frustration in MIC classrooms. The continued perceptions of MIC mathematics as harmful, despite several years of test results that do not support that belief, point out the need for districts to work hard to ensure that positive test results are publicized as widely and loudly as negative results.

The case of Ames also raises dilemmas about if, when, and how change should occur in districts with significant contingents of dissenting parents and teachers. Despite Ames' efforts to get all parties on board, the fact that some vocal teachers and parents were unhappy when change occurred has meant a long-standing battle that might have been avoided if teachers and parents had been offered a choice about elementary instruction, similar to what is now occurring at the high school level.

However, choice mechanisms can create not only curricular chaos within schools, but also increased inequality based on SES, gender, and race. For example, in the case of Ames, significantly more higher-SES students are now receiving Standards-based high school mathematics instruction, both because of parents' choices, and because the lowest-performing students who are not ready for regular Algebra 1 in 9<sup>th</sup> grade are receiving traditional instruction in a slower track. Hence, the choices being offered in Ames are exacerbating inequalities uncovered by Anyon (1981), who found that lower-SES students tend to be given didactic instruction, whereas higher-SES students are more often challenged to think critically and solve problems.



However, this study also raises the issue that not all students and parents want mathematics instruction centered around solving challenging problems. Despite years of experience with this type of instruction, the vast majority of Ames' 600 students and their parents believe students benefit more from traditional instruction. Although the author's general belief is that reformers should press on toward the goal of implementing Standards-based instruction, the views of parents and students should not be simply written off as naïve. Continued research is needed to determine if reform-based instruction does, indeed, benefit all students, and whether particular reform-based instructional strategies (e.g., group work, whole-class discussion) are more beneficial for some students than others.

Clearly there are no easy answers for districts attempting to reform their mathematics instruction. This article sheds light on diverse students' and parents' perspectives on reform-oriented mathematics instruction. Increased understanding of these perspectives can better position reformers, administrators, and teachers to address community concerns and to implement mathematics instruction that best meets students' needs.

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